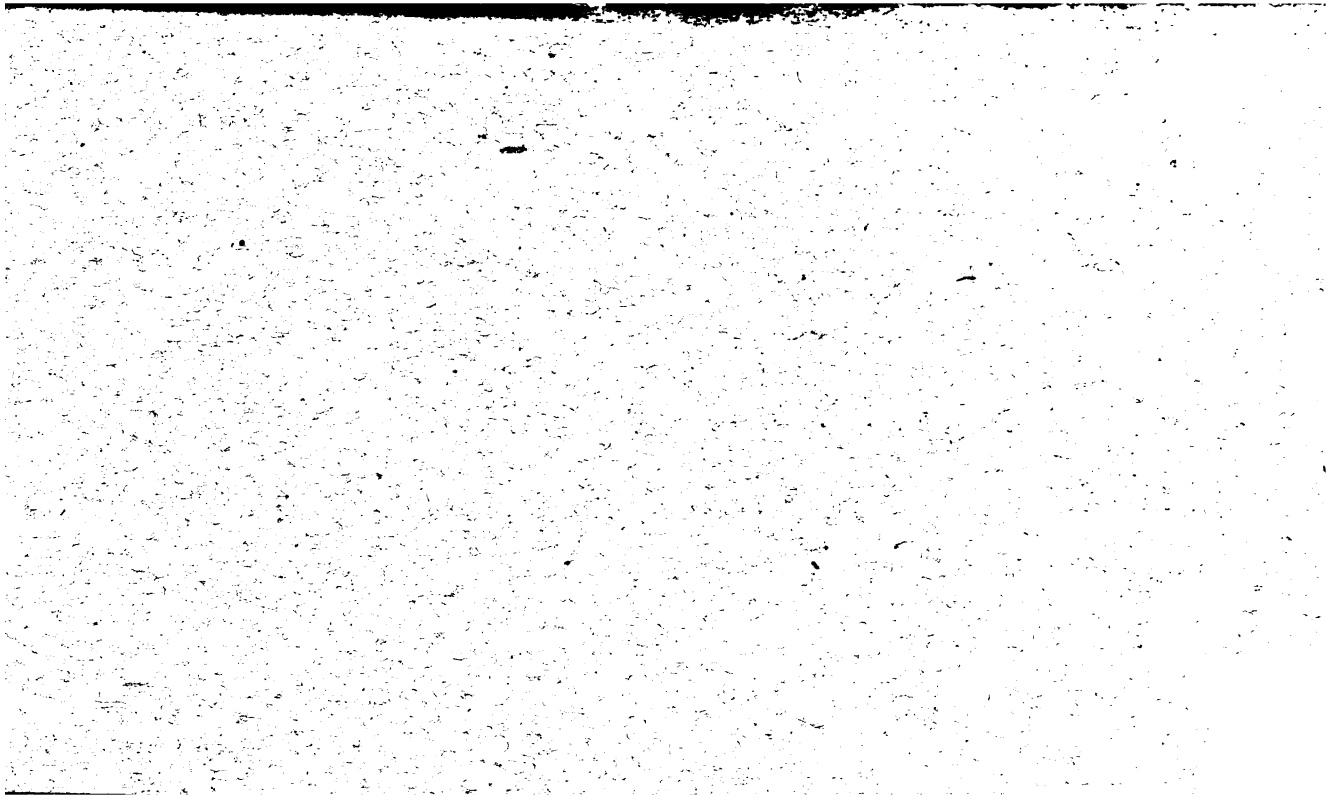

With the compliments of the author.

THE

DRAINAGE OF A HOUSE.

BY

WILLIAM PAUL GERHARD, C.E.,

CONSULTING ENGINEER FOR SANITARY WORKS, NEW YORK CITY

[*Reprinted from* "HOUSES OF TO-DAY."]

BOSTON:
PRESS OF RAND AVERY COMPANY.
1888.

THE DRAINAGE OF A HOUSE.

IN the "Homes of To-day" no feature is, to my mind, deserving of more attention from architects and house-builders than the sanitary arrangements, yet this very feature, which conduces so much to the well-being, comfort, and happiness of the occupants of a dwelling, is the one to which until quite recently far too little importance was attached. I believe I am not mistaken when I assert that the drainage of a house is, probably, to most architects, still the least attractive part of the numerous details of house construction. This fact is not surprising if we remember that a true architect should, above all, be an artist. Men who combine depth of artistic feeling with a profound knowledge of methods of construction and of the principles of sanitation, as applied to house-building, are rare indeed. Hence a new profession has sprung into existence, the members of which began to devote their attention to the hitherto neglected branches of architecture, not merely to the drainage and sewerage, but also to the ventilation, heating, water-supply, and much else involved in dwelling-house sanitation. Mr. Robert Rawlinson, C.E., has well said that "sanitary engineering is a new science, and as its main purpose is to make health, comfort, and a prolongation of life practicable, its study to a useful purpose must be important."

A large part of the writer's professional work consists in the proper arrangement of the sanitary drainage of buildings, hence it is assumed that the following

brief statement of some of the more important facts concerning house drainage will be of general interest.

During the last decade much progress has been made in sanitary knowledge, and in particular in the art of draining houses, and not the least useful result accomplished has been the better education of the general public in the details of domestic sanitary matters. Twenty or more years ago householders cared little or nothing about the final disposal of the foul wastes from houses. They were content if the plumbing work was arranged so that a free flow and discharge of water could be obtained at each sink, tub, or basin in the house, and appliances of improper construction, from a sanitary point of view, were retained, from ignorance or from reasons of false economy. Noisome and disagreeable odors about a water-closet were often tolerated as being necessary accompaniments of such fixtures. The danger of exposure, night and day, year in and year out, in bedrooms, living-rooms, or offices, to an atmosphere polluted by gases resulting from the decomposition of stagnant sewage matters, was wholly ignored, and the warnings of early reformers generally disregarded. In city dwellings the ample supply of water, which in turn serves as a vehicle for transporting refuse matters, and the more general introduction of the convenient plumbing fixtures, led, owing to the leaky condition of brick or earthenware drains under houses, to a sewage-sodden condition of the soil under basements. This is true not only of the vast number of buildings erected by shrewd speculators, but it applies alike to the palatial mansions of the rich.

Indeed, the death-rate from zymotic diseases increased, not only in houses with damp cellars, basements, and foundation-walls, but principally in those elaborately planned and richly furnished residences of the better class, where innumerable stationary wash-bowls, defective in arrangement, and tightly enclosed by decorative cabinet-work, were scattered in bedrooms all over the house. As the chief faults of the plumbing work in such dwellings, the following may be enumerated, viz.: the unnecessary multiplication

of fixtures, with its accompanying complication of the work; the leaky joints of soil and waste pipes; the broken and leaky drains; the coating of soapy or greasy slime attaching to the walls of waste-pipes; the partial or utter absence of ventilation; furthermore, the defective methods of trapping; the untrapped openings for the drainage of cellar-floors leading to the house-sewer; the accumulation of grease in traps under kitchen and pantry sinks; the lack of flushing in all parts of the pipe system, resulting in an accumulation of putrefying slime; the concealment of all work, and the bad workmanship of hidden parts of the plumbing; the untidiness of the spaces under fixtures; the injudicious location of water-closets and bath-rooms, and in particular the faulty position of the closet for servants' use, in out-of-the-way corners, without light and air; lastly, the befouled condition of servants' closets and housemaids' sinks, the offensiveness of the hidden interior of objectionable pan-closets, the deficient water-supply at fixtures on upper floors of city houses, the inefficient flush of valve-closets, the insufficient strength and unreliable support of lead pipes, and the careless exposure of plumbing work to injury by frost.

To say that all this has been changed in the past years would hardly be true, but it is safe to assert that radical improvements have been carried out. In some cities the most urgent reforms are now enforced by law, at least in the case of new houses. Yet, notwithstanding all this, it must be said that the character of the plumbing work in most modern houses is susceptible of much improvement, as I hope to be able to demonstrate. In my own practice, my chief aim has always been to awaken an interest in simplicity of construction, and, in this respect, my practice may differ from that of other reformers. I have, from time to time, made statements, describing what, in my opinion, are the cardinal requirements of good house drainage:[1] and I claim for them merely that they are,

[1] See the various works of the author.

first, the outgrowth of a large and varied practical experience in the supervision of drainage works in new houses, and in the remodelling of defective work; and, secondly, that they are the result of a careful study and comparison of all the sound methods proposed for the improvement of the sanitary condition of our homes.

Before alluding to the cardinal principles and fundamental requirements of good drainage, let me give a few words of general advice to people who intend to build. To begin with, if you build a house, keep the plumbing and drainage as a separate matter from your house contract. It cannot be denied that, where the whole work is given to one contractor, his chief interest — often his only interest — lies in the prospect of pecuniary gain. Thus, as a rule, the plumbing work is sub-let by him as cheaply as possible. There are, of course, among builders good men; but the result is, in at least nine cases out of ten, that the owner pays more to get an inferior job, and — what is more serious — in a house built for his own occupancy endangers the health of the members of his family by exposing them to the minor disorders of the system, to the graver ailments, and to the sometimes fatal diseases associated with bad drainage. To get even tolerably good work under the circumstances, is certainly the exception rather than the rule.

Supposing, then, that the owner follows this part of my advice by keeping the plumbing separate, the next question is, whether plumbing-work should be contracted for at a stated sum, or whether it should be done by days' work. I have, some years ago, pronounced emphatically against drainage work done by contract, and I see no reason now for changing my opinion. I still believe that the fairest way is to have such work done on a fixed percentage of profit to the contractor on all labor and material. At the same time, I cannot deny, and have frequently demonstrated in my own practice, that an entirely satisfactory plumbing job may be obtained by contract work. In this case, however, it is absolutely necessary that the fixtures

be properly located, the work carefully planned and arranged on scientific principles, that the contract be based upon a strict and detailed specification, and that the work be placed under intelligent supervision. Even then it is a wise precaution to hesitate to award the contract to "the lowest bidder," universal as the habit may be. It is an axiom of all good sanitarians, which the general public has been slow in accepting, that no house should be occupied as a human habitation until its sanitary condition, as regards drainage, sewerage, ventilation, and kindred matters, has been thoroughly tested. Therefore it is evident, that, in building a new house, much subsequent trouble and annoyance, not to mention serious illness, may be avoided if the above details of sanitary construction are put at once into the hands of an expert.

A few progressive architectural firms now follow the radical departure of employing regularly a sanitary engineer or plumbing expert to look after the sanitary details of houses. A number of others have the moral courage to tell their clients that they much prefer to have a specialist control the plumbing work in houses built under their supervision. I venture to predict that it will not be many years before attention to sanitation will be universally practised, and sanitary construction be represented by specialists in the leading architectural offices. There would certainly seem to be ample work on hand, and the results so far obtained where this practice is followed would seem to justify its more general adoption.

At present the prevailing custom is to leave too much of the detail of the work to the discretion of the plumbing contractor. It is quite evident, that, as the plumber's chief interest is that of a business man, he will not make particular efforts to simplify the work submitted to him, by adopting safer and less complicated methods than those called for by the average specification, and by cutting out and dispensing with unnecessary fixtures. Of course, there are exceptions; but they are decidedly in the minority. As a rule, plumbers are too apt to sneer at any attempt

of a radical departure from the methods of work handed down to them by tradition.

Owners, on the other hand, often nowadays place too implicit confidence in the supervision carried out by boards of health. While the results accomplished in cities where plumbing work is subject to regulations and official inspections have been most gratifying, it can not and should not be expected that, even with an increased force of inspectors, every individual house will receive sufficient attention. To illustrate: I have in mind a newly built house on the West Side of the upper part of the city of New York, which I was recently asked to inspect by a client who had purchased it immediately upon its completion. The work was done under board-of-health supervision, but evidently by a rascally contractor, with the result that the new owner had to spend about seven hundred and fifty dollars to put the plumbing into a merely tolerably good condition, by recaulking fraudulent joints in iron pipe, by re-fitting water-closets left with broken earthen trap connection, by remodelling sinks left imperfectly trapped, and by putting in a proper system of tank-water supply, — the house being fitted with plumbing apparatus on the upper floors, where in daytime the city water-supply failed. In order not to be misunderstood, I desire to state expressly that this is not cited as illustrating the imperfect supervision of boards of health, — for their inspectors accomplish as much good as would seem possible under the circumstances, considering the vast extent of the building districts assigned to each of them, — but only to warn the public against putting too much weight upon the statement, now so frequently encountered in announcements of real estate agents and building speculators, that "*the plumbing work was done under supervision of the board of health.*"

Again, neither architects nor owners should allow themselves to be guided — as is unfortunately too often the case — by the advice of dealers in plumbers' supplies or manufacturers of sanitary specialties. No matter how intelligent and ingenious they may be, their

judgment cannot be unbiassed. This is so obvious as hardly to require any further explanation.

In matters of drainage, perfect safety lies in absolutely faithful and faultless work. This can only be attained by employing first-class, honest, and thoroughly competent workmen, and by using first-class materials, fittings, and apparatus, by which I do not mean gilt-edged or decorated bowls, costly cabinet-work, fancy marble-work or tiling, and nickel or silver plated pipes. All such features are only "for show," and a perfect job, from a sanitary point of view, may be secured without them.

To give to housebuilders specific advice, I should counsel them to avoid all complication, and to aim at simplicity; to avoid having plumbing fixtures not in daily or constant use; to have what fixtures are needed conveniently located, without scattering them injudiciously over the house. Too much convenience in the shape of a profusion of fixtures increases the risk; while by reducing the number of openings into the waste pipe system, the amount of piping, and hence chances of leakage, are reduced correspondingly. Plumbing work should be confined mainly to the bath-room, the kitchen, pantry, and laundry. Some well-meaning friends have repeatedly expressed surprise at the stand-point taken by me in advising the banishment of all fixtures, washbowls or others, from sleeping and living rooms. I desire to state distinctly, that I consider it entirely feasible and practicable, in the present advanced state of the art of draining houses, to have in each bedroom of a house the luxury of a stationary washstand, with an abundant flow of hot and cold water, and made perfectly secure against entrance of sewer air. Convenient as such "set" basins may be, I, as a rule, advise dispensing with them in sleeping apartments, and unventilated closets adjoining them, in view of the possibility of imperfect work, particularly where plumbing inspection is not insisted upon. Moreover, it should not be overlooked, that, however safe plumbing fixtures may be originally constructed, the possibility remains of their

becoming unsafe under careless use and management.

In advising the employment of competent sanitary experts, I have, to some extent, a personal interest in view. This I cannot deny; but the force of the advice is not weakened by this admission, and it should not be overlooked that the public is ultimately the gainer. In support of my argument in favor of expert superintendence as regards sanitary construction, I may be permitted to quote what others have well said before me: "Sensible people, when they are ill, consult a physician, and not an apothecary. When they wish to plan a house, they take the advice of an architect, and not a builder. Both apothecary and builder are of course necessary." So it is also with sanitary experts. The sanitary engineer and the plumber are both necessary; but, while the execution of the drainage works of a house should be intrusted to a plumber, the design of the drainage system should be in the hands of a disinterested engineer. That so many householders, although considering the plumber "the pillager of their purses," still should persist in relying in the majority of cases solely upon his advice, is a matter beyond comprehension to me.

Whole volumes may be, and have been, written describing and explaining the general principles of sanitary plumbing. The essential points may be summed up in the following brief rules, viz.: —

Avoidance of any retention of filth on the premises by complete, automatic, and instant removal of all waste matter before decomposition takes place; thorough ventilation of the whole drainage system; abundant and frequent flushing of all fixtures, traps, and waste pipes; secure trapping of all vessels having openings in communication with the waste pipe system; avoidance of all manner of mechanical obstruction to the flow of waste water; durability of the work, soundness of materials, and tightness of joints; perfect accessibility to all parts of the work; noiselessness in operation of all fixtures; prevention of

unnecessary water waste by leakage, by freezing, or during flushing.

The cardinal rule in planning should be to observe the greatest possible simplicity of arrangement consistent with convenience and comfort. A fundamental requirement is the reduction of the number of fixtures, and another the concentration of waste discharges through as few well-ventilated pipe channels as possible. As an instance from my own practice, I may mention, that, in re-arranging the plumbing work for the main building of a large insane asylum in this State, I have grouped not less than ten water-closets, thirteen basins, three slop-hoppers, seven bath-tubs, one urinal, and one sink, on four floors, around a single line of soil pipe, kept freely open at the top and at its lower end; thus gaining not only the advantage of greatly reduced cost, but the benefit of an abundant flushing of the only soil pipe, together with compactness of arrangement. A multiplication of soil pipe stacks and long lateral waste pipes must both be avoided. Each fixture should have a direct and short connection to the soil pipe, if possible by a separate Y-branch. Each fixture should be separately and securely trapped. Where long branch waste pipes are unavoidable, they should have separate independent vent pipes through the roof. Lateral branches to the soil pipe, if not more than a few feet long, do not need this ventilation, provided the fixtures are quick emptying and in frequent use; for at each discharge of the fixture a movement of air takes place sufficient to avoid stagnation. All soil pipes should have ample ventilation at top and bottom, and their mouths above the roof should be enlarged, and kept unrestricted by any form of cover. All basins, tubs, and sinks should have large waste outlets, to empty quickly, and to fill the waste pipes, thereby securing a thorough scouring of the sides. I am in favor of using large supply pipes and valves and faucets with free waterway; but I also recommend using small waste pipes and small traps, as having a greater tendency to keep clean. Outlets of water-

closets, on the contrary, should in my judgment be restricted as much as is consistent with their safe use. Every discharge vessel in a house should act as a flush tank. All fixtures should be of a strong, durable, non-absorbent, and non-corrosive material, with smooth surface, and free from corners favoring accumulation of foulness. The question of overflow pipes has been solved in a simple manner by the introduction of a number of excellent appliances, doing away entirely with concealed overflow passages of any kind.

I favor the entire exposure of all spaces under plumbing fixtures and about pipes, for it should be constantly borne in mind that even the best workmanship and material cannot be expected to last forever, and leaks or other defects are more readily detected if the above advice is followed. Any one who has had occasion to carry out sanitary inspections will bear me out in the statement that all inspections are greatly facilitated where work is kept exposed. It should, therefore, be laid down as a rule in new work, to keep every thing in sight, to leave pipes and fixtures exposed to view, and traps and stop cocks accessible. This also promotes cleanliness, and greatly facilitates the carrying out of needed repairs or alterations. I advise closing all free communication, by the pipe channels, between the various floors of a building, in order to avoid the carrying about of local odors from one part of a house to another.

Without making any attempt to be exhaustive, I will mention at least a few matters of construction. All soil and waste pipes should be of heavy iron pipe, and restricted in diameter, so as to increase the flushing effect of a stream passing through them, thus avoiding deposits and subsequent stoppages. All piping should be made both air and water tight, drains should be laid with proper fall and true alignment, junctions should be made with Y-branches, and cleaning hand-holes should be provided in places where needed.

Traps for fixtures should have no enlargements or corners favoring accumulations of slime or sediment

and no mechanical obstructions should be countenanced. Traps should be self-scouring, made readily accessible by tight-fitting yet easily removable clean-out caps, and should have a water seal of sufficient depth, and perfectly secure against self-siphonage, back-pressure, capillary attraction, siphonage, and evaporation. From my best knowledge and belief, I cannot accept as universally necessary the requirement of "back ventilation" of traps. I conform to it, as a matter of course, wherever local board-of-health regulations require it; as I have also been compelled to run — always under protest — fresh-air inlet-pipes to grated openings in sidewalks, which choke with ice and snow in winter-time, and to cover soil pipes with the objectionable return bends and vent caps. I do not fail to explain to my clients that the back airing of traps is done at the expense of simplicity; that, in a properly laid-out system, trap vent pipes are not necessary to prevent dead ends in short lateral waste pipes; and that prevention of siphonage can be accomplished, and the extra cost incurred by back-air pipes be saved, in all but rare instances, by adopting simpler and well-known devices. Where I am compelled to run back-air pipes, complicating the pipe system, it is always my endeavor to modify the arrangement, so as not to expose the water in the trap too much to the air current; for there can be no question that the thereby increased free circulation of air in the vicinity of the sealing water of traps hastens the unsealing, by evaporation, of traps under fixtures which remain unused for some days in succession, and endangers the security of all traps during any period when a house is left unoccupied.

Water-closets have now come into almost universal use, even in cottages of moderate cost; and their advantages and comforts over more primitive devices are undeniable. A water-closet is the most important plumbing fixture in the house, and hence should be selected and put up with particular care. A good apparatus should fulfil the following requirements, viz.: it should be simple, neat, and compact in design

and construction; durable, strong, and not liable to breakage by careless use; of a smooth material, with ample standing water in the bowl; all parts exposed to fouling should be thoroughly scoured; the flush of the closet should be powerful, quick, copious yet noiseless; the water-closet should be securely trapped, and the trap kept if possible accessible, and its water-seal visible; it should be free from all machinery liable to get out of order, and should be economical in the use of flushing water required to keep it in a clean condition. There are a number of excellent water-closet appliances now in the market, which practically fulfil most of these requirements.

Properly arranged water-closets will also serve the purpose of a good urinal, and thus do away with a former abomination in houses. A clean slop-hopper or housemaid's sink on the bedroom floor of a house is an undeniable convenience to servants; yet rather than put it in a dark and unventilated closet, and leave it without means for flushing, I should advise using the water-closet in its stead.

As regards lavatories of all kinds, the first requirement is that the inlet and outlet openings should not be one and the same; for, if so, in filling the vessel, some of the dirty water comes back with the clean. This same objection applies to a number of waste-valves for bathtubs and basins designed to take the place of the ordinary chain and plug arrangement. The latter device has also radical defects, which are beginning to be more universally recognized and admitted. The outlets of the ordinary chain and plug fixtures are altogether too small in proportion to the diameter of their trap and waste pipe, with the inevitable result that both remain imperfectly flushed, and accumulate to some degree foulness. The chain and plug in the bottom of fixtures is inconvenient in use, and foul slime attaches to the numerous links of the chain, which are difficult to clean. Finally it becomes necessary with such fixtures to use hidden overflow channels, the inside walls of which receive no constant flow of water, hence become readily fouled; and, being

arranged so that they cannot be reached, they offer no chance for cleaning. The decaying soap slime coating the overflow passages remains in open communication with the apartment, and forms a serious objection, a standing nuisance, and a menace to health. Numerous patent contrivances have been invented, in which the aim has been to do away with the use of chain and plug, but which retain other objectionable features. Fortunately, washbasins, bathtubs, and sinks may now be obtained with standpipe overflow, which answer all the requirements which can be made to such apparatus. They have large outlets, causing a rapid discharge, and securing the incidental advantage of a thorough flushing of the trap and waste pipe. The inside of these fixtures presents a smooth and unbroken surface, the lift devices for the standpipe are convenient in use, and the standpipe itself can be readily disconnected for cleaning purposes. There is less labor for the plumber in fitting up such basins or baths; the number of joints to be made is reduced to a minimum; and every essential part of the fixture, including its discharge and overflow arrangement, is visible and completely accessible.

Concerning tests as applied to plumbing work during construction and after completion, there cannot any more at this date be the slightest doubt that security for work properly done lies in the clause of the contract specifying that all work will be submitted to rigid tests before being finally accepted. Experience deduced from my own practice is that a better class of work is turned out where these conditions are insisted upon, and I find that mechanics doing first-class work have no objection to any reasonable test applied to their work.

The fundamental rules and requirements hastily sketched above are applicable to all classes of buildings, to dwellings of moderate cost as well as to mansions and palatial residences. While writing this article, I have, among other work, charge of the drainage of a hospital, a schoolhouse, a club-house, a mission-house, a large fire-proof hotel, a row of apartment-houses,